

Some Insights for UCSD Pascal Generation

offered by Ken Bowles, 22 October 2004

I was your current age when Mark Overgaard & I started what became UCSD Pascal

- **It was 30 years ago (give / take a few weeks)**
- **I had just been forced to re-start in what amounted to 3rd of 5 careers.**
- **Some of the reasons for those re-starts may now, *or soon*, be familiar to you too.**

All but last (retirement) involved *engineering* at levels recognized as research in some major university engineering schools.

Rapid technology changes will (continue to) suggest you re-check reality occasionally.

Preview of this talk

Quick summaries of my 5 careers

- **Activities, Objectives, Successes in each**
- **Reasons for moving on**

Comments

- **All transitions messy**
- **Work *environment* is dominant – many *domains***
- **In modern engineering you're almost always member of a *team of people***
- **Team-based project-instruction works.**
- **Marketing success as important as technology**
- **Can't win all battles**
- **What realistically might have been different**

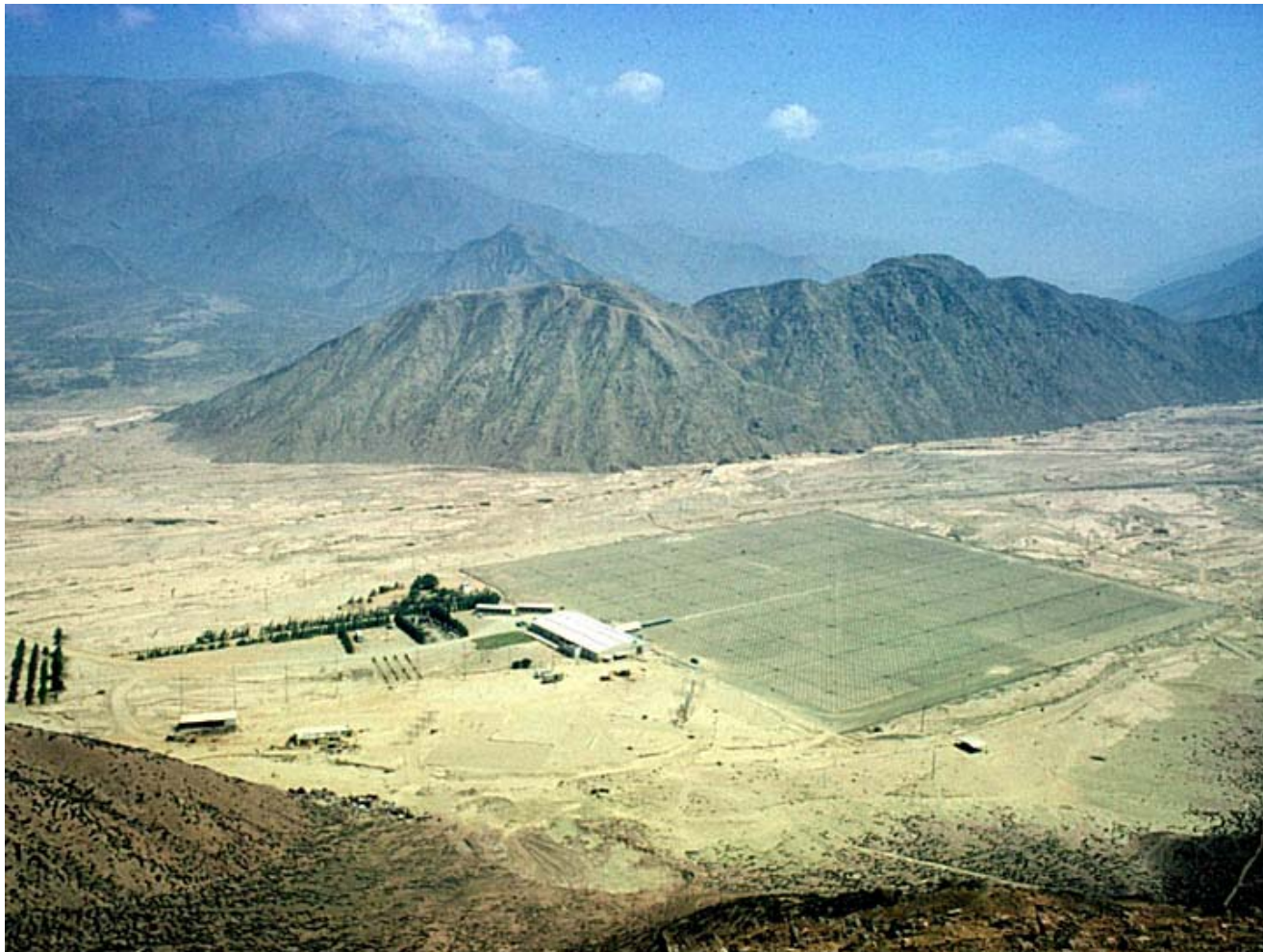
Engineering: “the discipline dealing with the art or science of applying scientific knowledge to practical problems”

(WordNet, Princeton University, 2003)

Career #1 - Radar Studies of Ionized Outer Atmosphere

We designed, built, and used this radar near Lima, Peru starting in 1960

- I worked for Central Radio Propagation Lab, Nat. Bur. Standards



Radars Studies -2-

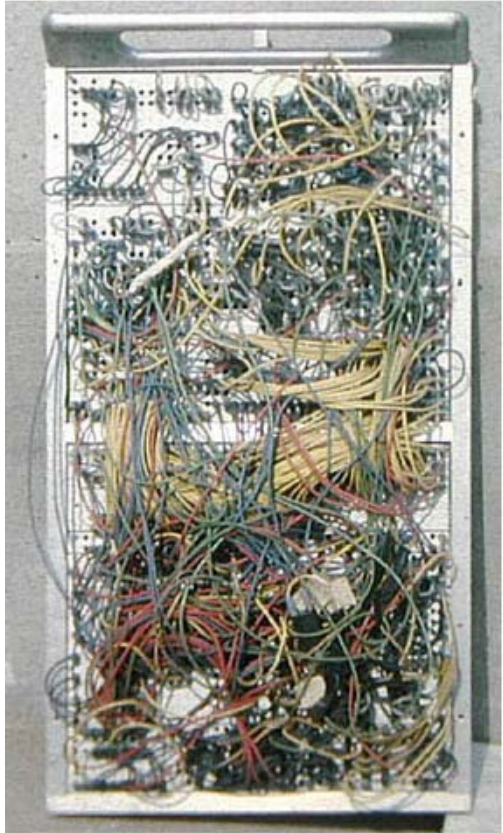
Antenna Array Closeup

- We re-invented unpublished German antenna design from mid 1930's



Radar Studies -3-

Computers we used in 1963 period



Wilkes microprogram controller for transmitter pulses



Packard-Bell PB250 computer with mercury delay-line memory.

Radar Studies -4-

Success with the science . . . but it had to end . . . 1964

- **Schools for our kids**
- **Budget competition amid changing national priorities**
- **Footnote: Jicamarca Radar Observatory now enjoying renewed US/worldwide support . . . re. satellite communications problems in equatorial ionosphere**

Invited to help start Applied ElectroPhysics Dept at UCSD . . . 1965

- **Gov't Lab to UC transition . . . culture shock**
- **Tangled with UC-wide restrictions re. lab computers**
- **Pushed into directing UCSD campus computer center**
- **Regrets at leaving Radar commitments and associations behind**

Director UCSD Computer Center -1-

1st Task . . . Replace aging CDC 3600 mainframe

- Chose Burroughs 6500
- Objectives . . . improved student & interactive services
- Controversial . . . no longer best number-cruncher available

Instant Introduction to Software Engineering

- Bx500 computers pioneered multi-program design, stack-machine
 - . . . but needed fix to handle *many* small student jobs
- Memory management and queue design were hot research topics
- UCSD task-scheduler fixes were used on B6500's in univ's worldwide

Director Computer Center -2-

Early participant in ARPAnet (now called *Internet*)

- Reason: National & Statewide budget crunches for research
- ARPA needed B6500 cycles for *Illiac-IV* development at U of Illinois
- UCSD computer center usage had dropped
- Collaboration with Burroughs & big users in tuning Op-System

Controversy grew . . . tried to serve many diverse user communities

- County/UCSD hospital budget crisis - admin computing blamed
- Big research number cruncher projects wanted supercomputer

But . . .

- *Burroughs* told me B6500 lease had been cancelled by UCSD . . . while I was at Oxford Univ conference, summer 1974
- I took instant sabbatical !!

UCSD Pascal -1-

Goal: Drastically increase student instructional computer use

Method: Take advantage of small computer price/benefit

Choice of Pascal

- **Niklaus Wirth's P-H book quickly adopted at >300 C/S dept's**
- **Urs-Ammann's P-machine allowed (almost) instant Pascal on diverse machines**
- **Pascal a big influence on adding *Science* to Computer Science . . . P-H editor Karl Karlstrom helped to *market* Pascal**

Computer Science only recently (in 1974) was getting accepted as university *discipline* independent of traditional disciplines

- **Combined Electronics, Mathematics, Psychology**
- **Established departments competed for control of C/S**

UCSD Pascal -2-

Engineering Approach

- **P-machine similarity to B6500 stack machine hardware**
- **Used Assembly Language to implement P-machine on PDP-11**
- **Compiled Pascal on B6500 to write primitive UCSD Operating System, and to *port* Ammann's compiler.**
- **Ammann's Pascal Compiler re-compiled for UCSD P-machine**
- **Students developed Editor, Filer, . . . on PDP-11 using Pascal**

UCSD Pascal -3-

Classroom Approach

- PDP-11 machines contributed by Digital Equipment Corp
- Used Keller's *self-paced* format for instruction
- Dared to teach intro-programming with Pascal for non C/S students . . . taught safer design habits
- Controversial among dept's who preferred FORTRAN as default . . . though already known to be obsolete

Persuaded Terak to build cheaper LSI-11 small computer

- Terak/UCSD design widely adopted at other universities

Outgrew Terak lab, and moved to network of Apple II's

UCSD Pascal -4-

Program Portability had grown to be a Major C/S Issue

- Proliferation of competing hardware/software prevented sharing of programs among collaborating groups in separate places
- Big NSF bucks were being spent on research looking for solution
- Intro of 8080 microcomputer end 1974 offered even lower costs for classroom
- Debut of competing LSI designs increased need for *portable S/W*

First Port to Z80 . . . a *Revelation*

- Lawrence & McCormack 1st trial demo in lab - early 1976
- First step . . . showed Sumner's Op System seemingly worked
- Plugged in floppy disk with Kaufmann's Editor
- All Pascal software worked on Z80 as on PDP-11 *with no change!!*

UCSD Pascal -5-

More CPU designs became popular . . .

More student implementation teams . . .

More \$\$\$ needed to pay for teams to work . . .

I went on road show with Terak box to demonstrate

- San Jose convention center . . . gasps of amazement !!
- EDUCOM, ACM conferences
- Cornell . . . to Tasmania C/S dept's

More \$15 licenses required serious Project *Infrastructure*

- Documentation, Tech-Support, Accounting, . . .

UCSD Pascal -6-

We *Extended* Wirth's Pascal Language definition

- Needed to achieve efficient software on microcomputers
- Influenced by *Smalltalk* success at Xerox PARC
- Pascal needed *Objects* to cope with complexity of large software
- *String* processing capability for non-numerical work
- Programming Interface (*API*) support for various objectives

With fame came controversy over *Tinkering* with Wirth's Pascal

- Purists regarded this as blasphemy
- We staged summer workshop seeking compromise toward international Pascal definition suitable for complex systems
- Proceedings distributed to participants . . . but never submitted for *publication* . . . we were overcome by events!!

UCSD Pascal -7-

The UCSD *Pascal Micro-Engine*

- Western Digital Corp built hardware for UCSD Pascal
- Team led by Mark Overgaard did the P-machine microcode
- Cited initially as proof of special CPU design advantages
- Barry Smith at Oregon Software soon proved that clever compiler design made Pascal code faster for the same chip with LSI-11 microcode

Licensing Controversy

- In late 70's every vendor sought competitive advantage by altering, extending, . . . designs obtained from others.
- UCSD Pascal license written to prevent identifying altered software as "*UCSD Pascal*"
- Though paid for by those \$15 fees, we were loudly accused of illegally preventing open use of code paid for by the public

UCSD Pascal -8-

UC Tax Status Sealed Our Fate in early 1979

- We were too successful !!
- Though making no profit, income exceeded \$10⁶ per year
- UC files no income tax return . . . but only if all income is from *Teaching, Research, Public-Service*
- UC-wide feared UCSD Pascal “*unrelated-business*” income would trigger IRS demand for *tax return for all of UC*

Three Options Offered

- Shut down “cold turkey”
- Ask Regents to request special IRS status for UCSD Pascal . . . might have established \$\$\$ were for public service, but would have involved 2 year project suspension
- License an outside for-profit vendor, and stop licensing from UCSD itself . . . *only choice fair to 1000’s of licensees already depending on us*

UCSD Pascal -9-

I Spent 6 Months Shopping For Vendor . . . Negotiating, Marketing

- **Talked a lot with people named Kildahl, Jobs, Gates and others who had small microcomputer software businesses**
- **Needed to select bidder with established business . . . led to SofTech, a software contractor to Fed Gov't and Industry**
- **UC-wide *Patents* Administrator controlled the license**
- **SofTech MicroSystems was the licensee . . . initially staffed by graduates of UCSD Pascal project**

Calif Fair Political Practices act . . . Proposition 9

- **Prevented split appointment that would have permitted me to influence MicroSystems business decisions that were counter to UCSD interests**
- **I might have helped UCSD Pascal to compete more “fairly” against MS-DOS . . . especially re. royalties**

Ada Language & TeleSoft -1-

Ada Language Design Sponsored by (D)ARPA starting late '70s

- **Competition among several software contractors**
- **Goal: basis for more reliable software in critical systems**
- **Extensive consultation with C/S people from many univ's**
- **Winning design strongly influenced by Pascal**
- **UCSD Pascal *Units* probably influenced Ada *Packages***

Western Digital CEO convinced me to start off-campus company

- **Goal: Build Ada-based software similar to UCSD Pascal**
- ***Tele...* name: Plan to deliver our products via telephone**
- **Initial Staff: Pascal project graduates & faculty colleagues**

Financial realities soon led to merger with Renaissance Systems

- **UCSD spin-off founded by former Computer Center student employees . . . the team approach had worked there too!!**

Ada Language & TeleSoft -2-

Market Realities Forced Us To:

- Concentrate on compilers only . . . initially for VAX machine
- Forget the *Tele* . . . another example when I was too early
- Seek additional venture capital . . . and I lost control of T/S

Loss of Engineer Control of Company

- Embarrassing promotion of flawed software
- Abandoned efforts to educate potential users about benefits of using Ada . . . though *marketing*, not enough profit

Eventual Sale of Company to Swedish Telecom Admin (*Telia*)

- Initial plan to employ TeleSoft Ada in new telephone switch
- Abandoned when Ericsson programmers demanded C++

Ada Language & TeleSoft -3-

ISO and ANSI Ada Standards

- **Early participation by UCSD Pascal “alumni” (both students and faculty) in DARPA’s Ada meetings led several of us to continue as members of ISO and ANSI Ada standards committees.**
- **Represented TeleSoft during 80’s & early 90’s**
- **I continued until Ada95 completed. Gary Dismukes is still involved (others too ??)**
- **Standards committees make decisions by consensus . . . they are important, but frustrating for participants.**

By 1995, TeleSoft had been merged/re-sold several times

- **I retired (from even part-time employment) then because we no longer had anything in common**
- **Most UCSD Pascal alumni had long since departed**

Thoughts in Closing -1-

Migration from Engineering to Non-Technical Issues

- Fact of life for most engineers
- Tends to start age 35 . . . 50
- Gets harder to compete with sharp people in their mid 20's
- Team development inevitably dulls all but the sharpest (those who are also most nimble coping with work environment)

Hard to avoid a career path explained partly by *Chaos Theory*

Darwinian evolution lamentably leads to less than optimum results.

- IBM, though dominant in 60's, has been passed by a small company started in an Albuquerque garage in 1975
- Ada, Macintosh, Mosaic/Netscape, . . . still superior but now just niche products
- Various outstanding products are now extinct . . . e.g. Burroughs stack machines, Xerox PARC's ALTO machine, . . .

Thoughts in Closing -2-

Young Individuals (or Partners) Still Make Outsize Contributions

- Marc Andreessen & Eric Bina, while students at Univ Illinois' NCSA, created *Mosaic*, 1st general Web browser, in 1992
- Larry Page and Sergey Brin launched *Google* while students working at Stanford's digital library project in 1995

The Right Venture Investor Can Make a World of Difference

- Mike Markkula took the Steve's (Jobs & Wozniak) under his wing to start and nurture Apple . . . one could *feel the symbiosis* when visiting their office

Software is fundamentally different from hardware

- Low manufacturing overhead, incentives to sell buggy S/W
- Too easy to tinker, low respect for standards
- Security concerns must/should not lead to rigid controls

Thoughts in Closing -3-

Serious Regrets

- **My inability to arrange thesis committees for several outstanding students**
- **Getting forced to lay-off good employees during occasional budget crunch periods . . . which I was helpless to prevent**

Serious Satisfaction

- **Long list of accomplishments by UCSD Pascal alumni**
- **Recent renewed worldwide dependence on Jicamarca Radar, and on those Peruvian and American old-timers still contributing to the project**
- **Legacy influence of UCSD Pascal designs . . . though *published* only thru software distributions**

Thoughts in Closing -4-

What Might Have Been . . .

- Richard Kaufmann has suggested that UCSD Pascal might have been allowed to continue at UCSD . . . had *Open-Source* licensing been accepted by UC at the time.
- **Headline: “California Considers Open-Source Shift” . . . CNet, 27 Aug 2004**
- Mozilla Foundation, Mosaic & FireFox licenses and support, widespread University participation . . . all provide an excellent updated model of what might have been
- ARPAnet provided the glue among many universities even in 1979 . . . and could have provided the “*Tele*”
- UCSD Pascal usage on IBM PC might have gone differently

Where would you be today had that happened? - Sigh

Thoughts in Closing -5-

Stay Active When You Retire



Osmadenia tenella (Three-Spot)

see <http://www.kenbowles.net>